SHAPE OPTIMIZATION AND OPTIMAL CONTROL OF GEOMETRICALLY EXACT STRUCTURES USING HERMITIAN DIFFUSE APPROXIMATION

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In this work we examine the issues related to the finite element formulation of shape optimization and optimal control of structures, which employs the geometrically exact model to obtain the governing equations and diffuse approximation based response surface to obtain an efficient solution of those equations.

Modern structures should often be designed to withstand very large displacements and rotations and remain fully functional. The goal is to control the large displacements and rotations of a structure of this kind being able to take it directly to an optimal (desired) final state. In this work we provide a finite element formulation for this class of problems, which remains valid for any size of displacements and rotations, thanks to using the geometrically exact structural models [1]. The latter also provides a possibility to obtain a set of coupled equilibrium and optimization (or control) equation, which is prone to direct, simultaneous solution procedure (see [2]). In order to make the solution procedure for this class of problems more robust, we employ a novel technique of Hermitian diffuse approximation, which is capable of identifying the solution admissible region in a very efficient manner.

Several numerical examples will be presented at the conference in order to illustrate a very satisfying performance of the proposed methodology.

References

[1] A. Ibrahimbegovic, R.L. Taylor, 'On the role of frame-invariance of structural mechanics models at finite rotations', Computer Methods in Applied Mechanics and Engineering, 191, 5159-5176 (2002)
[2] A. Ibrahimbegovic, C. Knopf-Lenoir, 'Shape Optimisation of Elastic Structural Systems Undergoing Large Rotations : Simultaneous Solution Procedure' Computer Modeling in Engineering Science, in press (2002)
[3] P. Breitkopf, C. Knopf-Lenoir, A. Rassineux, P. Villon, 'Construction and efficient minimization of response surfaces using diffuse approximation', 6th USNCCM, Dearborn, MI, 2001